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EFFECT OF NITROGEN AND ZINC ON GROWTH AND QUALITY CHARACTER OF WINTER MAIZE (*Zea mays* L.) UNDER IRRIGATED CONDITION OF PUNJAB

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ABSTRACT

Experiment was conducted during *rabi* season of 2015-16 at the Agricultural Research Farm Dhablan of the G.S.S.D.G.S. Khalsa college Patiala, Punjab. The experiment consisted of two factors viz. three nitrogen levels (N_0, N_{100}, N_{150} kg/ha) in main plots and four zinc levels (Z_0, $Z_{1.5}$, Z_3, Z_6 kg/ha) and was laid out in a Factorial Randomized block design replicated thrice. Before sowing, full dose of phosphorus, potassium at the rate of 60 kg P_2O_5, 40 kg K_2O through Single Superphosphate and muriate of potash was applied uniformly to each plot as basal dose. Full dose of zinc was applied through zinc sulphate and half dose of nitrogen through urea was applied to each plot as per treatment before sowing and remaining half dose of nitrogen through urea was top dressed in two equal splits, one at 30 days after sowing and 2nd at 7-8 days before tassel initiation stage. Plant height, Fresh weight, dry matter, no. of leaves/plant and protein content of winter maize increased significantly and consistently with nitrogen application @ 150 kg/ha and zinc levels @ 6 kg/ha.

Introduction

Maize (*Zea mays L.*) is one of the most important cereal crop in the world and is used as food, feed and in industrial uses. Maize belongs to Family "Poaceae" and originated from Central Mexico. Maize is important staple food crop of the world due to its higher yield potential, maize is popularly called as "Queen of cereals". Maize is a rich source of carbohydrates (68%) and constitutes a good source of human food and animal feed. As much of the Indian population is vegetarian, Maize is used as food for human and feed for animals and poultry. Two factors responsible for enormous success of maize as an industrial ingredient are its molecular versatility and development of high yielding seed varieties International maize trade is now larger than international rice trade. Nitrogen levels on Maize have considerable effect on growth, yield and quality Maize is an exhaustive crop it requires higher quantities of nitrogen during period of efficient utilization, particularly at 55 days after sowing and pre-tasselling stages for higher productivity. Winter maize has been observed to be highly responsive to fertilization, results in healthy crop and also helps in protecting against cold damage which is a pointer towards using higher doses of nitrogen to explore the yield potential in winter maize (Suryavanshi *et al*. 2008).

This situation is more alarming in developing countries where Zn deficiency is the fifth important factor causing ailments especially in children and women. Application of micronutrient also plays significant role in improvement of grain yield of maize. Among, micronutrient zinc plays an important role in photosynthesis, nitrogen metabolism and regulates auxin concentration in the plant.

Materials and Methods

A field experiment was conducted at Research Farm, Dhablan, and Khalsa College Patiala during Rabi season 2015.The experimental site is located in the sub tropical zone of Punjab 30^0-19´ North latitude and 76^0-24´ East longitude at an elevation of 250 meters above mean sea level. The climate of Agronomy Research Farm at Dhablan is sub-tropical with hot dry summer, hot and humid, rainy and cold winter months. The Monthly

mean minimum and maximum temperatures during the crop growth period

ranged from 13.2 to 26.8^{o}C, respectively. The mean minimum temperature of 7.6^{o}C was recorded in January and mean maximum temperature of 37.3^{o}C was noted in April month of 2016. The mean annual rainfall is 547-677 mm. Before seed sowing operation it was ensured that sufficient moisture for germination of seed is present in the soil. Presoaked and treated seed with Bavistin @ 2 g per kg were sown in the rows by kera method at spacing 45 cm x 25 cm. immediately after sowing, the lines were closed with soil and slightly pressed so as to have good contact of seed with soil.

Results and Discussion

Study of the investigation found that at 30,60, 90 and 180 DAS, the plant height increased significantly and consistently with nitrogen application @150 kg/ha and zinc application @6 kg/ha . The increase in the plant height at higher level of nitrogen could be attributed to the fact that nitrogen being an essential constituent of plant tissue induced rapid cell division and cell elongation. Suryavanshi *et al*. (2008) and Kumar (2008), Bangarwa and Gaur (1998) also reported significant increase in the height of Maize plant with nitrogen application up to 200 kg/ha. The increase in plant height may be due to the balanced application of Zn, as many researchers state that zinc is involved in a number of physiological processes of plant growth and metabolism. Zinc is required for the synthesis of tryptophan, which is a precursor of IAA, this metal also has an active role in the production of auxin, an essential growth hormone. Badshah and Ayub (2013) and El-Badawy and Mehasen (2011) also reported significant increase in the height of maize plant. on the other hand fresh weight and dry weight of plant at 30, 60,90 and 180 DAS show maximum fresh weight and dry matter accumulation with application of nitrogen @ 150 kg/ha and zinc application @6 kg/ha . The improvement in fresh weight and dry weight at increased levels of nitrogen and zinc might be due to increased metabolic activities, more cell growth and elongation. Increased dose of nitrogen thereby increased photosynthetic surface which paved the way for more production of fresh weight. The results are in agreement with the findings of Muhammad Aslam (2011), Rihab *et al.* (2012) and Ghaffari *et al*. (2011).

Study revealed that in the case of number of leaves/plant increased with application of nitrogen @ 150 kg/ha and zinc @ 6 kg/ha. Higher dose of nitrogen increased the growth of plant which increased the number of leaves/plant. There was rapid increase in number of leaves/plant between 30 to 90 DAS because of grand growth period and supplement of nitrogen at 30 DAS better met with the nutritional requirement of crop. The results are in agreement with the findings of Thakur *et al*. (1997) and Bukvic *et al*. (2003).

During the study, it has been found that the quality parameter viz. protein content showed significant and consistent improvement with increase in nitrogen application up to 150 kg/ha. Because nitrogen is a major nutrient, higher concentration of nitrogen application resulted into synthesis of more protein and higher availability resources. Bindhani *et al.* (2008) and Oktem (2008) reported that increase in protein content with increasing level of nitrogen. Zinc levels also show significant effect on protein content. Fecenko and Lozek (1998) and Jaliya *et al*. (2008) reported that each increasing levels of zinc up to 6 kg/ha increasing the protein content in maize grain due to zinc application which takes part in metabolism of plant as an activator of several enzymes and in turn may directly or indirectly affect the synthesis of carbohydrate and protein.

The variability observed in chemical composition is due to genetic and environmental factors which include time of harvesting, conversion of sugar to starch, gap in estimating the quality characters, type and place of storage etc. Consequently, N, P and K being involved in physic-chemical reactions in plant body of maize did behave accordingly to their effect on plant system and enhanced the values of quality parameters.

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Table:1 Effect of different combination of nitrogen and zinc on growth characters of winter maize

Treatment Combination	Plant Height (cm)				Fresh weight (gm)				Dry matter accumulation (gm)				No. of leaves/plant			
DAS	30	60	90	180	30	60	90	180	30	60	90	180	30	60	90	180
Z_0N_0	19.70	37.20	65.30	170.80	5.80	50.20	116.30	621.40	1.00	19.20	22.30	206.20	6.10	9.50	11.10	15.40
Z_0N_1	21.80	38.50	72.20	172.90	7.10	54.20	120.20	639.90	1.20	19.80	26.50	210.70	6.70	9.80	11.30	15.90
Z_0N_2	23.00	39.60	73.60	175.20	8.10	58.40	125.60	711.00	1.40	22.50	30.60	215.00	7.10	9.90	12.20	16.40
Z_1N_0	21.30	37.40	70.90	171.80	6.50	52.50	118.70	635.50	1.20	19.40	23.70	208.20	6.30	9.60	11.30	15.80
Z_1N_1	23.60	41.80	74.00	180.40	9.40	60.20	135.40	721.90	1.60	25.20	35.10	225.20	7.40	10.10	12.10	16.70
Z_1N_2	24.50	43.20	74.70	182.60	10.60	64.90	143.30	744.60	1.90	26.70	39.20	245.30	7.70	10.30	12.30	17.10
Z_2N_0	22.50	40.60	72.20	174.40	7.90	57.70	123.30	689.50	1.60	22.30	27.20	220.90	6.70	9.90	11.50	16.20
Z_2N_1	24.50	43.50	76.50	185.60	11.70	68.90	150.60	795.90	2.00	28.70	42.50	300.20	8.10	10.70	12.60	17.30
Z_2N_2	25.80	45.10	80.30	193.00	12.80	77.60	156.90	841.20	2.20	31.60	44.70	328.40	8.30	10.90	12.70	17.50
Z_3N_0	25.10	43.70	77.70	188.40	12.20	74.40	155.40	805.50	2.10	30.00	43.40	314.60	8.30	10.80	12.70	17.30
Z_3N_1	26.40	47.50	81.90	195.50	13.60	88.40	162.50	900.80	2.70	32.70	46.60	378.70	8.50	11.00	13.10	17.80
Z_3N_2	27.70	49.00	84.20	202.20	15.30	98.20	172.60	941.50	2.90	33.60	49.90	427.10	8.50	11.20	13.60	18.10
CD 0.05 N*Z	0.58	0.95	1.32	1.26	0.79	1.50	1.60	2.30	0.59	0.82	1.09	2.40	0.24	0.38	0.25	0.28

Table:2 Effect of different combination of nitrogen and zinc on Protein (%) of winter maize

	Z_0	Z_1	Z_2	Z_3	Mean
N_0	6.70	8.40	8.70	9.50	8.29
N_1	8.50	8.90	9.40	9.70	9.11
N_2	8.70	9.10	9.60	9.80	9.30
Mean	7.95	8.76	9.22	9.67	

	F-TEST	SE(d)±	CD 0.05
Nitrogen	S	0.090	0.18
Zinc	S	0.10	0.21
N*Z	S	0.18	0.37

NOTATION:

Z_0 = Control N_0= Control

Z_1 = 1.5 kg/ha N_1 =100 kg/ha

Z_2 = 3 kg/ha N_2=150 kg/ha

Z_3 = 6 kg/ha

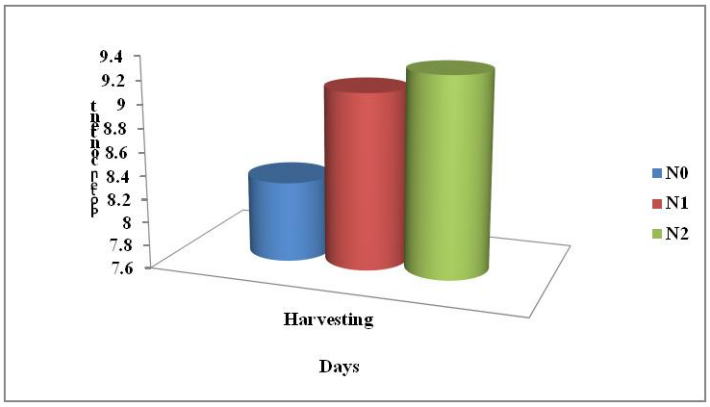

Figure:1 Effect of Nitrogen on Protein content (%) of winter maize

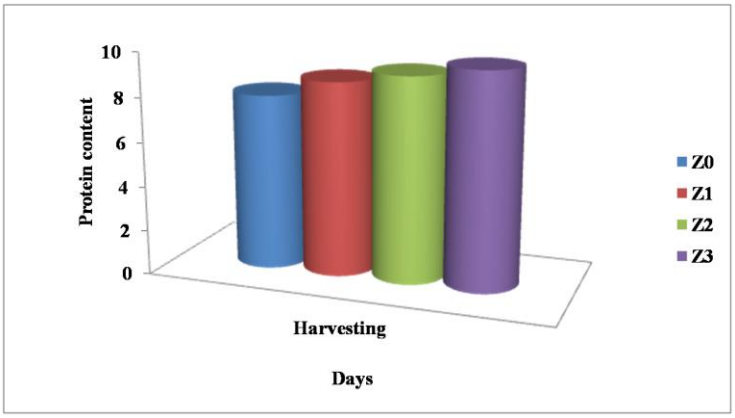

Figure: 2 Effect of Zinc on Protein content (%) of winter maize

Conclusion

Application of nitrogen at the rate of 150 kg/ha and zinc at the rate of 6 kg/ha had significant effect on growth characters as well as protein content. Zinc application with the combination of nitrogen proved to be suitable for obtaining significant improvement in the growth and quality of winter maize. Thus the results of the study lead to the conclusion that to realize maximum growth and protein content, the crop needs to be supplied with 150 kg/ha nitrogen and 6 kg/ha zinc. However, the study requires more critical testing at various locations with staggered survey before final recommendations are made.

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